Sub B2

10. (New) The method of claim 1 wherein the object is a vacuum insulation material.

11. (New) The method of claim 1, further comprising steps of predetermining a calibration curve showing a relation between the thermal conductivity and the temperature difference and applying the measured temperature difference to said calibration curve to determine the thermal conductivity of the object.

REMARKS

Claims 1-7 were previously pending in the present application. In an Office Action mailed November 6, 2002, Claims 1-7 were rejected and objections were raised with respect to Claims 2, 3, and 7 because of informalities. More specifically, Claims 1-4 stand rejected under Section 102(b) based on U.S. Patent No. 5,251,980 to Hiraoka and Claims 5-7 stand rejected under Section 103(a) based on Hiraoka '980 in view of the Japanese Patent Publication No. 62172248A to Nakamura.

By this amendment, Claims 1- 7 have been amended and new Claims 8-11 have been added to provide more clarity; and Claims 2, 3, and 7 have also been amended to resolve the Examiner's objections.

The application currently contains pending Claims 1-11. Applicants respectfully request reconsideration of the application in view of the above amendments and the following remarks.

A. Claim Objections

Claims 2, 3, and 7 were objected to because of informalities. Applicants above amend the claims, and all claims are now believed to be in conformance with the Examiner's formality requirements. No new matter has been added.

B. Response to Section 102 Rejection – Hiraoka '980

Claims 1-4 stand rejected under Section 102(b).

The Examiner rejected these claims on the grounds that Figs. 3c-1, II and 18 of Hiraoka '980 disclose every element of each of these Claims. Applicants respectfully disagree.

1. Different Heat Flow

Hiraoka '980 as best represented in its Fig. 18 discloses a technology of measuring thermal conductivity by generating heat in a thin film heater 21 positioned between an object and a heat resistant material, and causing the heat to conductively flow horizontally between the object and the heat resistant material. That is, Hiraoka '980 receives and measures the heat flowing in a horizontal direction. Because of the horizontal temperature measurement, the size of a heat generating area, i.e., the thin film heater 21, cannot be a significantly important factor for the temperature measurement. Further, thermal conductivity of Hiraoka '980 around the heat generating area is also horizontal and therefore factors such as surface temperature and the shapes of the object and the heat resistant material greatly influence the temperature measurement. Accordingly, accomplishing precise and accurate measurement with the Hiraoka '980 system is difficult.

The present invention discloses a technology of measuring thermal conductivity by generating heat between surfaces of the object and a heat resistant material; causing heat to flow from the surfaces of the objects and the heat resistant material into an interior of the heat resistant material; and calculating the thermal conductivity of the object from a temperature difference between at least two vertically aligned locations positioned along the heat flow path the positions being spaced apart about or inside the heat resistant material. Further, as shown in Fig. 2 of the present invention, a heat generating area is approximately equal to an entire surface area of each object and heat resistant material contacting therewith. Accordingly, comparing to Hiraoka '980, heat flow of the present invention is hardly influenced by the above-described factors like surface temperature and shapes of the object and the heat resistant material, thereby remarkably increasing the preciseness and accuracy of the measurement.

2. Steady State Requirement of Hiraoka '980

Hiraoka '980 as shown in Fig. 18 has a heat sink 5 so as to create a steady state within the system. Understanding from the Equations (1) and (6), Hiraoka '980 needs to do

so because it can conduct the measurement only upon/after the temperature difference ΔT becomes steady. It is well-known fact that creating a steady state requires a long period of time, and it is also fact that the Hiraoka '980 device cannot be used for measuring heat insulating materials because of their lower thermal conductivity and characteristic of requiring an enormous amount of time to reach steady state.

The present invention without a heat sink provides very stable heat flow and determines the thermal conductivity by simple calibration curve without waiting for the steady state. Therefore, the present invention conduct the measurement in about 120 seconds instead of the enormous amount of time required with the cited device.

3. Steps of Determining Heat Conductivity

Hiraoka '980, for example in Fig. 18, measures the temperature difference (a) in Fig. 18 prior to the contact with the object and then measures the temperature difference (b) after contacting with the object in order to determine the thermal conductivity utilizing the differences therebetween. Accordingly, Hiraoka '980 has a problem of numerous steps of measurement and longer measuring period.

The present invention on the other hand conducts the measurement after contacting the object, which facilitates and simplifies the step and also reduces the measuring period.

4. Size and Thickness of the Object

An object sampled in Hiraoka '980 is rather small and thin, for example Ls = 10mm, Ws = 2mm, ts = 150, see line 16, column 16. Because of all the problems already described above, Hiraoka '980 could be made for measuring a small and thin object. If an object is rather large and thick like insulation materials with poor thermal conductivity which takes an enormous amount of time to obtain steady state and emits heat in a various directions, Hiraoka '980 has a problem in obtaining an accurate measurement because of the lateral heat measurement.

The present invention was made to clear the problem raised by Hiraoka '980 and is capable of providing fast and accurate measurement because of the vertical heat measurement.

5. Vacuum Heat Insulation Material

Since a vacuum heat insulation material uses a material with a better thermal conductivity on the surface (e.g., a metal film), the thermal conductivity varies in different (vertical/horizontal) directions. Therefore, if an object is a vacuum heat insulation material, Hiraoka '980 will have difficulties in conducting the measurement.

C. Response to Section 103 Rejection – Hiraoka '980 in view of Nakamura '248

Claims 5-7 stand rejected under Section 103(a) on the ground that Hiraoka '980 in view of Nakamura '248 disclose every element of these claims.

For the same reason stated and explained in Section B above, Claims 5-7 are patentable under Sections 103(a) over the combination of Hiraoka '980 and Nakamura '248.

D. Amendment

Amendments in Claims 1 and 4 and newly added claim 8 with respect to "vertical internal direction" are supported by the description between line 27 on page 4 and line 6 on page 5 of the current specification. Amendments in newly added Claims 9 and 10 with respect to "heat insulating material" and "vacuum insulation material" are supported by the description on page 10 between lines 9 and 18. Newly added Claim 11 is supported by the description on page 9 between lines 4 and 19.

E. Conclusion

In light of the foregoing, all of the pending claims are in condition for allowance. Applicants therefore respectfully request reconsideration of the application and allowance of all pending claims. If the Examiner wishes to discuss the above-noted distinctions between the claims and the cited references, or any other issues, the Examiner is encouraged to contact the undersigned attorney by telephone.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version With Markings to Show Changes Made.**"

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Title:

The title has been amended as follows:

~~HEAT~~ THERMAL CONDUCTIVITY MEASUREMENT METHOD AND INSTRUMENT AND METHOD OF PRODUCING A HEAT INSULATING MATERIAL

In the Claims:

Claims 1-7 have been amended as follows:

1. (Amended) A method of measuring ~~the heat~~a thermal conductivity of an object, comprising:

~~generating heat~~positioning a heat source between and in contact with a surface of the object and a surface of a heat resistant material;

aligning the object, the heat source, and the heat resistant material along a substantially vertical axis;

causing heat to flow along a heat flow path from the heat source into ~~through~~ the object and an interior of the heat resistant material; and

calculating the ~~heat~~ thermal conductivity of the object from a temperature difference between at least two spaced apart locations aligned substantially parallel to the vertical axis, the locations being against ~~about~~ or inside the heat resistant material.

2. (Amended) The method of claim 1~~,~~ wherein the heat source has a central area and an auxiliary area surrounding the central area.

3. (Amended) The method of claim 1~~,~~ wherein ~~the~~ an externally exposed surface of the heat resistant material is covered with a cover member.

4. (Amended) An instrument for measuring the ~~heat~~ thermal conductivity of an object to be measured, comprising:

a heat resistant material having heat resistance;

a temperature difference measuring unit capable of measuring a temperature difference between two locations spaced apart about or ~~within~~ inside the heat resistant material; and

a heat generating unit configured to be placed vertically between ~~on~~ the surface of the heat resistant material and a surface of the object, wherein the heat generating unit generates heat between the surface of the object and the surface of the heat resistant material, causing heat to flow from said surfaces of the object and the heat resistant material into an interior of the heat resistant material, ~~is placed such that the heat generating unit comes in contact with the surface of the object to be measured~~, and the ~~heat~~ thermal conductivity of the object to be measured is obtained from a temperature difference between at least two ~~points~~ locations positioned vertically along the heat flow on the surface of or internal to~~of~~ the heat resistant material and object.

5. (Amended) The instrument of claim 4~~,~~ wherein the heat generating unit comprises a main heat generating section for generating heat in a central area and an auxiliary heat generating section for generating heat in an area surrounding the main heat generating section.

6. (Amended) A method of determining the suitability of a heat insulating material, comprising an inspection step in which heat is generated between the heat insulating material and object and a heat resistant material and caused to flow through the heat insulating material and the heat resistant material, and a measurement step in which the ~~heat~~ thermal conductivity of the heat insulating material is obtained from a temperature difference between at least two points of the heat resistant material.

7. (Amended) The method of claim 6~~,~~ wherein the heat generation area is divided into a central area and an area surrounding the central area.